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HEP Theory Group

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HEP Division

Argonne National Laboratory

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Theory in National Laboratories

Apart from the essential requirement of doing good physics, Theory groups at National Laboratories should fulfill three main roles:

- Support of the experimental groups, in keeping them up-to-date with the latest theoretical developments in their respective fields of interest.
- Basic research in topics not directly connected with the present Laboratory activities:
  A broad range of subjects must be covered, facilitating the introduction of experimenters to alternative ideas that could form the seeds of future projects or searches.
- Organization Workshops and Visitor programs, bringing to the laboratory experts in a variety of fields, increasing the visibility of the laboratory and the exposure of local scientists to the latest ideas in HEP.

Synergy of Theory and Experiment

A good synergy of Theory and Experiment at the Laboratories requires

- Theorists working on areas closely connected to experiment
- Theorists willing to communicate to experimenters the recent advances in the field.
- Experimenters willing to listen to these ideas and to discuss the latest results in the field.

It is clearly possible to improve the communication between theorists and experimenters at ANL:
Theorists at Argonne work on topics of Collider physics, QCD, Higgs physics, heavy quarkonia, bottom and top quark physics, supersymmetry and extra dimensions.
All these topics are of interest for physics analysis at HERA, the Tevatron, the LHC and a future Linear collider.

Present Composition of the Group

- The HEP Theory Group has Five Permanent Staff Members:
  Ed Berger, Geoff Bodwin, Don Sinclair,
  Carlos Wagner, Cosmas Zachos.

- It has, at this point, no Junior Scientist Member.
- The activities of the Group have been reinforced by a number of postdoctoral appointees.
- The number of regular postdoctoral fellows supported by the HEP Division in the last years has fluctuated around four.
- Additional postdoctoral appointments, however, have been achieved by the acquisition of LDRD Grants, or by agreements between the Laboratory and the Univ. of Chicago.

ANL-University of Chicago connection

Carlos Wagner is an Associate Professor at the Univ of Chicago. Joint appointment with Argonne National Laboratory, since 1999.

Collaborative effort between ANL and the Univ. of Chicago led to the appointments of D. Kaplan, C. Chiang and G. Servant.

The three of them have obained long-term positions before or shortly after the end of their appointments at Argonne. We expect one additional joint postdoctoral appointment for the coming year.

Joint Junior Faculty Position

- Idea: Take advantage of new program to create joint junior faculty position in HEP phenomenology.
- Developed in a serious way after meeting of members of Argonne and Univ. of Chicago with R. Rosner.
- Initiative presented to the Univ. of Chicago Physics Department. Voted favorably in an unanimous way (Vote: 20 to nothing).
- Search Committee: Ed Berger, Carlos Wagner, Jon Rosner and Emil Martinec.
- Several excellent candidates were identified and invited to give talks.
- After an intensive and time consuming search, we were informed that the University had started the search for a senior candidate and therefore abandoning the joint initiative.

Future of the Joint position with Univ. of Chicago

- In May, Chicago made a formal offer to H. Murayama.
- Nothing could be set in motion again before Murayama gave an answer to Chicago's offer.
- Murayama declined the offer on Sunday, November 30.
- A new agreement with the Univ. of Chicago should be now reached in order to start a new search, avoiding the repetition of the frustrating experience of last year.
- It is perceived that R. Rosner should play a major role in putting this agreement in formal terms. Rosner expressed continuing support for this initiative.
- Even if everything goes OK, a formal search will have to wait until next year.

Impact of the Theory Group on HEP Division Activities

- Effort is being made to increase visibility of the group, through the organization of workshops and meetings.
- Since May, 2002, the group has organized:
  Workshop on SUSY, Higgs and Extra Dimensions.
  Greater Chicagoland Meeting.
  Workshop on Neutrino Physics.
  Workshop on Heavy Quarkonia.
  Workshop on Brane Dynamics.
- For the coming year, there are plans of Organizing a new Workshop on Higgs, Supersymmetry and Extra Dimensions, as well as one on QCD in extreme environments.
- There is also an effort towards increasing the interaction between different theory groups at ANL : Ed Berger was the Organizer, of a recent Argonne Lab-wide Theory Afternoon. C. Wagner has been acting as the Head of the ANL Theory Committee, in charge of obtaining recommendations to improve the situation of theory at ANL.

Status of Theory at ANL

Theory Group has gone through a major review process about a year ago.
Eminent scientists, working on a broad range of fields in theoretical high-energy physics, formed part of the review committee, including Mark Wise, Michael Peskin, George Sterman, Al Mueller, Carleton DeTar and Jim Gates.

Conclusion of the Review: The theoretical group received high marks. All present members were ranked as having excellent or outstanding performance.

One member of the group was laid off after the review. This action was not recommended by the reviewers, but followed from his lower ranking as well as budgetary and DOE pressure.

Future of Theory at ANL

Future research activities must concentrate on the most exciting problems facing contemporary particle physics. They should be in line with the main activities of the laboratory, the roadmap defined by P5, and the DOE priorities :

a) Standard Tevatron and LHC Physics, with emphasis on QCD, top-quark and Higgs physics.

b) Beyond the Standard Model Physics: Supersymmetry, Extra Dimensions, Strong Dynamics, String (M or Anthropic) Theory; with emphasis on future connections to LHC and LC physics.

c) Neutrino physics.

d) B-Physics, with emphasis on CP-violation and Beyond the Standard Model effects.

e) Connections to Cosmology and Astroparticle physics.

Recent Activities

- In recent years, the Theory Group had an important productivity in all these areas, with the main exception of Neutrino Physics.
- Attempt to fill the gap in Neutrino Physics was made, via the Joint Faculty position with the Univ. of Chicago.
- The appointment of new junior faculty members, working on these areas would be highly desirable.
- Most of the researchers hired at the postdoctoral level concentrated on Collider physics, Higgs physics, Beyond the standard model physics, Heavy quarkonia and Cosmology.
- Lattice gauge theory and abstract theory activities have received little support at the postdoctoral level.

Lattice Gauge Theory and Computing

The Theory Group has been involved in lattice gauge theory projects for several years.

It is perceived that actions can be taken to strengthen this effort:

- Integration of ANL lattice group into large lattice collaborations. Are they really functional ?
- Collaborate with other ANL computing groups.
- A more aggressive search for grants to support postdocs.

D. Sinclair will give his personal views on these matters.

Abstract Theory

In the last years, one senior and one junior member (now departed) of the group have been working on abstract theory.

Is there a role for these kind of activities at a National Laboratory ?

In the opinion of many colleagues, including the Theory Review Committee, the answer is yes.

Members of the laboratory working on formal aspects of high-energy physics can fulfill an important role:

They can provide the connectivity of the Division to the ever-shifting world of developments in abstract theory, string theory and beyond.

Greater emphasis is being put on (applications to) main topics of interest in High Energy Physics.

This is in line with DOE and Theory Review recommendations.

Astroparticle physics and Cosmology

Members of the Division are interested in taking part in Astroparticle physics experiments, like SNAP and Auger. The Division is now involved in R&D activities for Veritas. The Theory group has been working on the interface between particle physics and cosmology. They have concentrated on

- Origin of the Baryon Asymmetry of the Universe
- Origin of the observed Dark Matter Energy Density

I can forsee an involvement of members of the group in SNAP and Auger, both connected to issues particle physicists care about:

- The origin of Dark Energy.
- The origin of the highest energy cosmic rays

Veritas, instead, deals with issues of hard astrophysics (gamma ray astronomy), where the Theory Group has little chance of contributing in an efficient way.

Recent ANL and External Funding Awards

- Argonne Theory Institute 2003,
  Trends in Neutrino Physics: $20K awarded to the Theory Group of the HEP to organize a Workshop, which took place between May 11–17, 2003.
- Laboratory Graduate Student Program: Support for D. Morrissey, to do his thesis under the supervision of C. Wagner at the Theory Group of the HEP Division, $ 24 K awarded for the first year, starting in April 2003.
- Argonne Individual Investigator Award, October 2001, “Extra Space-Time Dimensions ”, $ 57 K awarded to E. Berger and C. Wagner, for two years of research effort on extra dimensions. Supported appointment of T. Tait 2001–2002; made possible appointment of B. Murakami beginning in fall 2002.
- Argonne Theory Institute 2001,
  “New Physics at the Electroweak Scale: From Supersymmetry to Extra Dimensions ”, $ 20 K awarded to E. Berger and C. Wagner.